SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Derive time dependent schroedinger equation and discuss the concept of stationary states and wave packets.

17. Discuss the Kronig Penny model and demonstrate the splitting of energy levels and the obtaining of energy bands.

18. Obtain the Heisenberg equation of motion in Heisenberg representation where the operator changes with time and state vector remains constant.

19. Discuss the barrier penetration by particles using WKB method. Hence obtain expressions for reflection and transmission coefficients.

20. Obtain eigen values for J^2 and J_z.

NOVEMBER/DECEMBER 2025

23PPH22 — QUANTUM MECHANICS — I

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. If A and B are two Hermitian operators check whether the following
   (a) $(AB + BA)$ and
   (b) $(AB - BA)$ are Hermitian or not.

2. State Uncertainty principle

3. Define reflection and transmission coefficients.

4. Define zero-point energy.

5. What is Heisenberg picture?

6. How will you define parity of operator?

7. What is meant by Stark effect?

8. What is variation method?

9. What are Ladder operators? Why are they called So.

10. What are Pauli spin matrices?

SECTION B — ($5 \times 5 = 25$ marks)

Answer ALL questions.

11. (a) Discuss the physical interpretation of eigen values and eigen functions.

Or

(b) State and explain the postulates of quantum mechanics.

12. (a) A particle having energy E is incident on a finite barrier of height $V_0 = (E < V_0)$. Illustrate the wave function in the different regions and also calculate the Transmission coefficient (T).

Or

(b) Solve the radial part of Schrodinger equation for the hydrogen atom and obtain the energy eigen values.

13. (a) Obtain the Schrodinger equation of motion in Schrodinger representation where the state vector changes with time and operator remains constant.

Or

(b) Write the symmetries and conservation laws.

14. (a) Discuss the first order corrections to the energy and wave function for a system with non-degenerate energy levels in perturbation theory.

Or

(b) Obtain the expression for the ground state energy of normal helium atom.

15. (a) Find angular momentum matrices for $j = \frac{1}{2}$, $j = 1$, and $j = \frac{3}{2}$.

Or

(b) Obtain Clebsch Gordan coefficients for addition of angular momenta for electron in the state $j_1 = \frac{1}{2}$ and $j_2 = \frac{1}{2}$.